

## **Norovirus Infections**

### **Public Health Importance and Outbreak Management**

Outbreaks of viral gastroenteritis reported to local health departments are usually community-based, involving adults or older children. These outbreaks are typically caused by the Norovirus (previously called Norwalk-like Virus) which affects these age groups. Outbreaks involving preschool children which occur in institutional settings such as childcare centers or pediatric wards are more likely to be caused by the viruses that cause diarrhea in early childhood (e.g. rotavirus, adenovirus, calcivirus, or astrovirus).

In outbreaks of gastroenteritis, investigators often face the problem of having to take action before an etiologic agent can be identified. This problem particularly applies to outbreaks caused by viruses, since laboratory diagnosis can be delayed for days or weeks. Distinguishing viral from bacterial or protozoal etiologies is sometimes difficult because of overlap in clinical syndromes, but prior testing to rule out bacterial causes is recommended.

The following information will focus on the Norovirus that often causes gastroenteritis outbreaks in settings where older children and adults are living in crowded circumstances.

### **Clinical Syndrome of Norovirus**

#### **Signs and Symptoms**

The incubation period for clusters of disease caused by the Norovirus is 12 to 48 hours, and the average duration of illness is 12 to 60 hours. The symptoms are characterized by the acute onset of:

- Nausea
- Vomiting
- Abdominal cramps
- Watery, non-bloody diarrhea.

These symptoms are experienced by all age groups, but diarrhea is more common among adults, whereas more children experience vomiting. However, all individuals can experience vomiting alone. Constitutional symptoms such as headache, fever, chills and myalgia are frequently reported. Severe dehydration caused by Norovirus gastroenteritis can be potentially fatal, especially in the elderly. No long-term sequelae of Norovirus infection have been reported, but the elderly often report persistence of constitutional symptoms for several weeks.



## **Mode of Transmission**

Noroviruses have a very low infectious dose and therefore can be easily transmitted through droplets, fomites, person-to-person transmission, and environmental contamination. Documented routes of transmission include contaminated water, contaminated food (especially raw shellfish and salads), ice which has been handled, and aerosolized vomitus.

## **Length of Infectiousness**

Norovirus is shed for at least 48 to 72 hours after resolution of all symptoms. Recent studies, however, have demonstrated the presence of virus in the stool for several months after infection. Additional research is needed to accurately determine the length of infectiousness.

## **Treatment**

For most people, viral gastroenteritis is a self-limited illness of a few days duration, with virus replication restricted to the mucosa of the gut. The main risk is of dehydration and electrolyte imbalance. Maintenance of good hydration is important, particularly among the elderly and those receiving diuretic medication. Hospitalization and treatment with intravenous fluids are required only for cases in which dehydration is severe, or in which the caretaker cannot provide adequate oral rehydration.

## **Immunity**

Most persons' antibody levels against Norovirus rise after infection; these titers normally peak by the third week and persist until approximately the sixth week, after which they decline. The nature of resistance and susceptibility to the Norovirus is poorly understood, but it is likely that previous exposure to a strain of Norovirus provides some immunity against severe disease if reinfected with the same strain.

## **Outbreak Characteristics of Norovirus**

Numerous reports have described the course of outbreaks caused by Norovirus, usually involving older children and adults. The settings are diverse and include banquets, cruise ships, nursing homes, health-care facilities, cafeterias, recreational lakes, swimming pools, campgrounds, hotels, schools, fast food restaurants, and others. Norovirus probably circulate at a low background level of infection in a community until an infected individual contaminates a common source, and an outbreak occurs. Although secondary cases can multiply the number of persons affected, outbreaks are generally limited to 1-2 weeks unless transmission is facilitated by a closed environment such as a cruise ship or prolonged by renewal of the susceptible population, such as new admissions to a hospital ward.

## **Specific Outbreak Situations**

### Nursing Homes and Residential Institutions

Large and protracted outbreaks of viral gastroenteritis have occurred in nursing homes and institutional residences. Risk factors in such settings include the density of living quarters and decreased personal hygiene among some residents because of incontinence, immobility or reduced alertness. Diuretic medications and debility among this population can increase the risk of an adverse outcome in what otherwise might be a mild diarrheal episode.



### Cruise Ships and Camps

The close living quarters of ships and camp dormitories amplify opportunities for person-to-person transmission of viral agents. Gastroenteritis outbreaks would normally end after all susceptible persons have been infected; however, in such settings, new and uninfected populations usually arrive every 1 or 2 weeks, thereby renewing the epidemic. Norovirus outbreaks extending over five successive cruises have been documented.

### Pediatric Wards and Daycare Facilities

Continuous close contact among unrelated children, some of whom may be ill, can accelerate the progression of endemic diarrhea through a small population into an outbreak. Nosocomial and day-care transmission of rotavirus during its peak season is particularly efficient and difficult to control. Calicivirus, adenovirus, astrovirus and Norovirus particles are found more frequently in stool specimens from children in these settings than from children in other settings.

### Restaurants / Catered Events

Investigations of foodborne Norovirus outbreaks have implicated various food items, drinking water and ice. Food items such as lettuce and herbs can be contaminated by sewage before entering the kitchen, or ill food handlers can contaminate food items during preparation. The risk for contamination through foodhandlers is increased when the food item is consumed without further cooking (e.g., ready-to-eat foods) and when a semi-liquid food (e.g. cake frosting or salad dressing) is contaminated so that a small inoculum is mixed and spread to multiple persons.

## **Outbreak Control and Management**

Clinical and epidemiological signs that suggest the presence of Norovirus in outbreaks of acute gastroenteritis include:

- Stool specimens that are negative for bacterial and parasitic pathogens,
- Percentage of cases with vomiting more than 50%,
- Average duration of illness of 12-60 hours; and
- Average incubation period of 24-48 hours.

Most outbreaks of viral gastroenteritis are self-limited; however, certain factors create risks of intense or prolonged transmission that may require aggressive intervention. These risk factors include closed environments (e.g. nursing home), a constantly renewing population of susceptible persons (e.g. children at camp), or persons at special risk (e.g., the elderly). Whatever the initial source of the outbreak, subsequent viral transmission is often person-to-person, with both direct fecal-oral and airborne transport probably involved. Although interruption of this transmission may be difficult, the following measures may be helpful in controlling the spread of infection.

### **1. Rule out the possibility of a bacterial infection**

Due to the length of time to identify a viral agent by laboratory testing, typically an assumption of the causative agent is made upon the clinical presentation of the outbreak resembling past outbreaks of Norovirus. To ensure that another cause is not missed, it is recommended to test several stool samples for possible bacterial causes of gastroenteritis, such as *Salmonella*, *Campylobacter* and *Shigella*. Especially, if the diarrhea persists for 2



or more days, has blood in it or there are other clinical symptoms present that do not match the typical symptoms of viral gastroenteritis.

## **2. Identify and eliminate a common source**

For Norovirus outbreaks, if an ill food handler is the source, it is typically too late to remove them from work as they have recovered from the illness. However, water, ice, and shellfish are other possible common sources. When a water supply is thought to be contaminated with Norovirus, shock chlorine concentrations (greater than or equal to 10 mg/L for 20 minutes or longer) may be helpful.

## **3. Prevent employee acquisition of illness**

Since person-to-person transmission is common once Norovirus has entered a population, it is important to review standard infection control practices with all employees, especially foodhandlers and housekeepers, emphasizing:

- The importance of handwashing. Hands are the most likely way the virus spreads. Hands should be washed before and after each patient contact, as well as on entry and exit from affected rooms/wards/units. The recommended procedure is to rub all surfaces of hands with plain soap or an antimicrobial-containing product, rub lathered hands together vigorously for at least 10 seconds, and then thoroughly rinse the hands under a stream of water.
- Personnel coming into direct contact with ill persons should wear disposable plastic gloves that are removed and properly disposed of upon completion of the interaction.
- When contamination of clothing with fecal material or vomitus is possible, personnel should also wear gowns. Since spattering or aerosols of infectious material is involved in disease transmission, wearing of masks should be considered, particularly for persons who clean areas grossly contaminated by feces or vomitus.

## **4. Prevent employee transmission of the illness**

In many settings, employees (e.g. health-care providers, staff of daycare centers, housekeeping staff) are at highest risk for transmitting disease because of their many contacts with ill persons. Any staff member with symptoms that suggest a possible viral gastroenteritis should be sent home from work immediately and excluded from contact with potentially susceptible persons for at least 48 hours after resolution of illness. This exclusion is particularly important for food handlers, who should not be involved in preparing food during this period.

## **5. Prevent visitors from spreading the illness**

Visitors to ill patients should be restricted to ensure that the virus is not spread. Visitors should wear clean gowns to affected wards or rooms, and wash their hands before and after visiting patients with symptoms. Any visitor with symptoms of gastroenteritis should refrain from entering the wards. It is important to ensure that visitors of ill patients do not visit other patients in their rooms. As far as possible, children should not be permitted in wards during an outbreak because of their susceptibility to infection.

## **6. Minimize Contact Between Well and Ill Persons**

When possible, ill persons should be isolated from well persons until at least 2 days after resolution of symptoms. In certain settings (e.g., camp, cruise ship, hotel or nursing home), the clinic may function as a focus of transmission; persons with complaints of gastroenteritis should be seen by medical care personnel in the patient's living quarters, or in a separate area of the clinic.



Unless absolutely necessary, suspend transfer of patients between wards or to other institutions until patients have been symptom-free for 48 hours. If patients must be transferred, the ward or institution must be advised of the outbreak so that they can take appropriate precautions to prevent the transmission of infection in their establishment. Restrict new admissions to the ward(s) until the outbreak has ended. Dedicate staff to one ward to prevent the introduction of the illness to another part of the institution.

#### **7. Use safeguards with laundry**

Soiled linens and clothes should be handled as little as possible and with minimum agitation to prevent microbial contamination of the air and persons handling the linen. Laundry should be transported in an enclosed and sanitary manner (e.g. in a plastic bag if the laundry is wet or moist), promptly machine-washed with a detergent in water at the maximum cycle length, and then machine dried.

#### **8. Clean Soiled Surfaces**

There are no hospital disinfectants registered by the U.S. Environmental Protection Agency (EPA) that have specific claims for activity against noroviruses. In the absence of such products, CDC recommends that chlorine bleach be applied to hard, non-porous, environmental surfaces in the event of a norovirus outbreak. A minimum concentration of 1000 ppm (generally a dilution 1 part household bleach solution to 50 parts water) has been demonstrated in the laboratory to be effective against surrogate viruses with properties similar to those of norovirus. Healthcare facility staff should use appropriate PPE (e.g. gloves and goggles) when working with bleach.

Quaternary ammonium compounds are often used for sanitizing food preparation surfaces or disinfecting large surfaces (e.g., countertops and floors). However, because noroviruses are non-enveloped, most quaternary ammonium compounds (which act by disrupting viral envelopes) do not have significant activity against them.

Phenolic-based disinfectants have been shown to be active against noroviruses in the laboratory. However, this activity may require concentrations 2- to 4-fold higher than manufacturer recommendations for routine use.

Previous studies of disinfectants have used feline calicivirus (FCV) as a surrogate for norovirus; the use of FCV as an acceptable surrogate for noroviruses is under review by the EPA. The only product with an EPA-approved claim against FCV is the peroxygen compound Virkon-S® (EPA registration number 62432-1)\*. If selected for disinfection of environmental surfaces, this product should be used in accordance with the manufacturer's instruction. Proprietary disinfectant products should be used on pre-cleaned surfaces to ensure maximum performance.

There are available disinfectants that have activity against other non-enveloped RNA viruses that cause enteric disease (e.g., hepatitis A virus and poliovirus). However, it is not known if these disinfectants would be equally effective against norovirus.

Heat disinfection (i.e., pasteurization) has been suggested for items that cannot be subjected to chemical disinfectants. A temperature equal to or greater than 60°C (140°F) has been used successfully under laboratory conditions.

(Source: Centers for Disease Control and Prevention (2005)  
[www.cdc.gov/ncidod/hip/gastro/norovirus.htm](http://www.cdc.gov/ncidod/hip/gastro/norovirus.htm))

Because environmental surfaces have been implicated in the transmission of enteric viruses, bathrooms and rooms occupied by ill persons should be kept visibly clean on a routine basis. Potentially contaminated areas include toilets, showers, bathrooms, pantry,



patients lockers and surrounding areas including walls, floor, benches, taps, toilet and door handles, etc.

Feces and vomitus collected during the cleaning procedure should be promptly disposed of in a manner that prevents transfer of this material to other surfaces or persons. Persons performing these tasks should wear appropriate protective barriers (e.g., latex gloves—and if splashing is anticipated, a mask or face shield and garments such as a uniform, jumpsuit or gown to protect street clothing).

#### **9. Stop renewal of susceptible population**

In situations in which the epidemic is extended by periodic renewal of the susceptible population (e.g., camps, cruise ships, hotels), the facility or institution may need to be closed until it can be cleaned and disinfected properly.

#### **10. Monitor the outbreak**

Prepare a list of all persons who have been affected by the illness (including staff) together with their ward/room/work location, and date and time of onset of symptoms. Analyze this information to determine the spread of the outbreak and whether it is being controlled.

#### **11. Communicate with all staff about outbreak**

Communication about the outbreak with all staff, including agency staff, is essential. Briefings should be provided giving clear instructions to staff outlining:

- Transmission of viral gastroenteritis and infection control procedures;
- Cleaning and disinfection procedures;
- Isolation of affected patients;
- Transfer of patients;
- Visitors;
- Discharge of patients;
- Ill staff to remain away from work for 48hrs after symptoms cease; and
- Names and contact numbers for the infection control personnel.

### **References**

1. *Attachment 3 – Controlling an Outbreak of Gastroenteritis – Guidance for Institutions.* From Victoria, Australia Department of Public Health Website [www.health.vic.gov.au](http://www.health.vic.gov.au). Specifically: <http://www.dhs.vic.gov.au/phd/9902113/attach3.pdf>.
2. *Morbidity and Mortality Weekly Review (MMWR)* April 27, 1990/ 39(RR-5);1-24.
3. *Morbidity and Mortality Weekly Review (MMWR) Recommendations and Reports.* “Norwalk-Like Viruses” Public Health Consequences and Outbreak Management. June 01, 2001 / 50 (RR09);1-18.
4. *Viral Infections in Humans: Epidemiology and Control.* Edited by Alfred S. Evans. Third edition. Chapter 11 “Viral Gastroenteritis” Albert Z. Kapikian and Robert M. Chanock. Pp. 293-340. 1991.
5. *Gastric Flu Outbreak in Hotels: Pilot Guidelines for FTO Members.* Professor Rodney Cartwright. Microdiagnostics. UK. 2002.